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ABSTRACT

This study investigated the differences in the reading rate of eighth grade students on a cloze reading exercise involving the reading of text from a computer monitor. Several different modes of presentation were used in order to determine the effect of prior experience with computers on the students' reading rate. Subjects were 240 eighth grade students selected from computer literacy classes in seven schools located in a large suburban area. They were randomly assigned to one of four treatment groups: white text on black background, black text on white background, white text on light blue background, and black text on light blue background. A Pearson correlation was used to analyze differences based on questions relating to previous computer usage. In addition, a two-way factorial analysis of variance (ANOVA) was performed using type of user and color group as the independent variables, with reading rate as the dependent variable. Neither the effect of color nor the amount of previous computer experience was found to be statistically significant in influencing reading rate. Correlation and ANOVA data are presented in two tables. (19 references) (GL)

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The Effects of Computer Usage on Computer Screen Reading Rate

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ABSTRACT

The use of computers in schools has more than tripled in the 1980s. These computers are being used as much for instructional lessons as programming. Many of the current instructional programs use color to highlight text or make the lesson more interesting. The question is if previous computer usage effects the ability to read computer screens?

This study investigated the differences in reading rate of eighth grade students on a cloze reading exercise involving the reading of text from several different modes of presentation on a computer. The study was designed to determine if some types of experience using a computer effected reading rate.

The subjects were selected from computer literacy classes in seven schools located in a large suburban area and were randomly assigned to one of four treatment groups. A Pearson correlation was used to analyze differences based on questions relating to computer usage. Differences were found effecting reading rate in age starting using the computer and amount of time using the computer.

The Effects of Computer Usage on Computer Screen Reading Rate

In 1975, the introduction of computers into elementary and high schools was made possible by the marketing of relatively inexpensive computers (Braun, 1981; Hofstetter, 1985; Wold & Hunter, 1984). By 1982, the computer market was flooded with inexpensive computers.

In 1980, there were approximately fifty-two thousand computers used for instructional purposes, in approximately 48% of the public school districts in the United States (For your information: Computers in schools, 1982; National Center for Educational Statistics, 1982). Between 1980 and 1984, the number of computers in K-12 schools more than tripled (Billings, 1987; Dickey & Kherlopian, 1987; Market Data Retrieval, 1985). These computers were being used as much for instructional lessons as to teach programming.

The drop in the cost of computers in 1982, opened the market to the family. These new computers brought the world of computers into the home. Recent studies estimate that approximately 10 percent of all homes in the United States have at least one computer system (Drude, 1989). The main emphasis in the home computer market is entertainment and educational value (Drude, 1989). The educational value is an outgrowth of the introduction of computers into the schools. Thus, a small but growing percentage of students today are being exposed to computers at home as well in schools.

Versatility of Computers

Computers in the home and in school are used for a variety of purposes: to make work easier, to entertain, and to educate. People use computers to make work easier by using software to process words, manage data, and manipulate numbers. Entertainment software allows people to play games, draw pictures, and create music. Educational software aids people in learning new skills and concepts. For entertainment applications color and graphics are more important while text display is of lesser concern. For work easing and educational applications text display is important.

Educational tool programs are text based. Although some graphics are used, the emphasis is on reading of text from the computer screen. As computers become a more integral part of education, students will be required to read more text from the electronic screens than ever before. Color is used as a motivating aspect or highlighting feature of educational software (Schmitt, 1989) and color has been part of application software for as long as there have been color monitors.

Purpose of this Study

Research on previous computer experience and its effect on ability to read, from a computer screen, has been limited. Gould, Alfaro, Barnes, Finn, Grischkowsky, & Minuto (1987), in a

series of experiments, found no difference in the adults' ability to read from a computer screen based on previous computer experience. To this date, no studies have been found investigating previous computer experience's relationship to children's ability to read computer screens. Specifically, do years of experience using a computer, amount of usage per week, and type of usage affect reading rate?

These three measures of experience seem to be most important for determining computer exposure. The first two aspects, experience and amount of usage, indicates how ergonomically accustomed the students are to using and reading a computer screen. The third aspect, type of usage, provides information relating to the amount of text the user might be accustomed to reading on a computer screen. The latter aspect is amplified in usefulness if students have been using computers from many years and several hours a week but only play games on the computer.

Additionally, evidence exists to indicate that reading rate may be negatively impacted when computer screens are used (Gould, Alfaro, Barnes, Finn, Grischkowsky, & Minuto, 1987; Gould, Alfaro, Finn, Haupt, & Minuto, 1987; Hansen, Doring, & Whitlock, 1978; Kruk & Muter, 1984; Muter, Latremouille, Treurniet, & Beam, 1982). Many factors such as color, screen resolution, line length, brightness, contrast, etc. were studied. When comparing reading from paper to reading from computer screens, no one factor stood out as a cause for poorer reading rate, although several factors seemed to have cumulative negative effects. But,

these studies cited used adult subjects. Two studies, Fish and Feldmann (1987) and Clausing (1988), used junior high students and found no appreciable impact upon reading rate when a computer screen was used.

Subjects

Two hundred forty subjects, from computer literacy classes, were selected from schools in a large suburban school system. The number of students actually participating in the testing was 265. Of this number 25 were eliminated because of factors precluding the use of the student's data.

Seven schools participated in the study. Based on the percentage of free lunch students the schools selected were a representative sample of the socio-economic climate of the system. Fifty-three students from two socio-economically low schools, one hundred thirteen students from three socio-economically average schools, and seventy-four students from two socio-economically high schools participated in the study.

All of the subjects were eighth grade students. Sixty-six students were 13 years old, 111 were 14 years old, 44 were 15 years old, 17 were 16 years old and 2 were 17 years old.

Procedures

Subjects participated in a practice session to familiarize them with cloze techniques and computer software usage. During the practice session students filled out a questionnaire pertaining their previous computer experiences. Before participation in the experiment, students were randomly assigned to one of four treatment groups: white text on black background, black text on white background, white text on light blue background, and black text on light blue background. The black and white color combinations were investigated because black text on a white background is used in normal paper text, white text on black background is the default color for IBMPC Junior computer screens. The black text on blue background was chosen because a study done by Pace (1984) concluded that this color combination was optimal. The white text on blue background was chosen to represent a combination with less contrast as Bouma (1980) and Tinker (1963) found lack of contrast to be an important factor in legibility.

Pearson product-moment correlations were performed comparing the three features of computer experience with reading rate. Additionally, a two-way factorial analysis of variance (ANOVA) was performed. The ANOVA used type of user and color group as the independent variables with the dependent variable reading rate.

Results

The report of the findings is divided into three sections the descriptive statistics, correlations, and analysis of variance.

Descriptive Statistics

The questionnaire was designed to assess the subjects computer experience as it related to reading rate. Computer experience defined by this questionnaire was initial exposure to computers, hours per week using a computer, and type of computer usage.

The first question asked students at what age they first used a computer. The mean age at which subjects reported their initial use of computers was approximately ten years. The standard deviation was 2.7 years. The youngest age of initial computer use was three while the oldest was 16.

The second question asked students to estimate the time they spent, out of school, at a computer for the two weeks previous to the study. One hundred twenty-four students reported spending no time on computers. The longest reported time was 35 hours. The mean time reported was 4 hours. The standard deviation was approximately 6.5 hours. The mean time for students who reported spending any time at all on computers was 7.28 hours.

The third question asked students to classify themselves as one of six types of computer users: "new users", "game player", "bored user", "worker", "very experienced", or "other". Of the 240 students: 62 classified themselves as new users, 101 as game

players 9 as bored users, 7 as workers, 25 as very experienced, and 36 as other. Of the others, 14 could be classified as game players and workers, 8 as users of computers for multiple reasons, 3 as programmers, 2 as non-users, and 9 others that could not be classified.

Almost 50 percent of the new users began computing between the age of 13 and 16; these students accounted for almost 12 percent of the entire sample. Only 10 students in the 13 to 16 age group classified themselves as something other than a new user or game player. Eighty-eight percent of the game players first used a computer between 6 and 12 years of age. No game player used a computer before age 6. These younger game players accounted for 37 percent of the entire sample. Additionally, 97 percent of all experienced users were in the 6 to 12 age groups.

Correlations

Four Pearson product-moment correlations were performed to determine if certain types of computer experience were related to reading rate. The correlations were: (a) reading rate with comprehension, (b) reading rate with the reported starting age of computer use, (c) reading rate with time reported using computers outside of school, (d) reading rate with type of user. Table 1 presents a summary of the correlations of reading rate and the 3 questionnaire items.

Insert Table 1 About Here

The correlations performed on reading rate with comprehension scores indicated subjects with faster reading rates had higher comprehension scores (r=-.275 p<.0001). This correlation provided evidence that the students made an honest attempt to comprehend the reading material. Subjects who started using computers at an earlier age had faster reading rates (r=.291 p<.0001). Subjects reporting more time on computers outside of school had faster reading rates (r=-.203 p<.0001).

The effect sizes for all of these correlations were relatively low. They ranged from 4 percent to 8.5 percent. It seems as though starting age has a modest affect on reading rate. Likewise, amount of computer time away from schools slightly affects reading rate.

Analysis of Variance

A two-way factorial ANOVA was performed. The number of responses and their relationship to each other in the six categories of questionnaire item 3, indicated that the six groups need to be compressed into two groups. Group 1 became the combination of new users and game players. Group 1 individuals could be characterized as students who rarely read text from a screen but often look at color on a computer screen. Group 2 is the combination of workers, very experienced, and others. These students could be characterized as individuals who frequency read text from a computer screen. Although group 2 students had more experience reading text, they were probably familiar with

software using color. The degree of color exposure is difficult to determine for group 2 because of the variety of application software packages available. Nine students, those who characterized themselves as board users, could not be placed in a category and thus were omitted from this analysis.

The ANOVA used reading rate as the dependent variable and color group and type of user as the independent variables. Neither the color group nor the interaction of the color and type of user had a statistical or educational affect on reading rate. But, the type of user was statistically significant. The factorial ANOVA results are presented in Table 2.

Insert Table 2 About Here

The effect size was eight percent. This may be notable since it provides some indication of an outside, uncontrollable, computer experience that might affect the educational use of computers. Investigating the differences in the means indicates that the students who were in the group that would read more text from the computer screen did read faster on the computer screen than the group of new users and game players who might not have read much text from a computer screen. The means were 13.95 minutes and 11.32 minutes, respectively for groups 1 and 2. This is supported by a Pearson correlation of -0.287.

Conclusions

As Clausing (1988) indicated, the affect of color on reading was not statistically or educationally significant for junior high school students. For this study, the color effect in and of itself as well as the interaction with previous computer experience was not statistically or educationally significant. Thus, if there is a "reasonable" contrast between the background color with the text, there appears to be no appreciable difference in reading rate for junior high school students.

Some notable finding were discovered from the questionnaire of these junior high school students. Substantially more students who did text work on the computer first used a computer before the age of 13, most began using computers between the ages of 6 and 12. Thus, most students who have read text from a computer screen have used computers throughout their elementary school years. Secondary school teachers have no control over their students' previous computer experiences. This study indicates a need for further study of how computer usage affects reading rate. In addition further study needs to be done to determine possible ways of changing teacher attitude toward implementing software usage in secondary schools. Most students sit at a computer screen and are told to work with a particular instructional package. The students are given a minimum amount of attention. If the student is not experienced with reading text from a computer screen, reading rate will be affected and

thus learning may not be as efficient as with printed text. Thus, practices and policies of computer usage in secondary school could be affect.

A suggested remedy for the situation is the development of a **SHORT** user inventory for teachers to use for determining if the students have had experience reading text from a computer screen. If the student has not had much experience reading from a computer screen, then interventions, such as one-on-one tutoring sessions with student/teacher/computer, placement of students in optimal ergonomic reading positions, and practice exercises reading from a computer screen, should be provided prior to having instructional material presented to them via a computer.

A secondary school teacher has no impact on students' computer experiences during the first 12 years of the student's life. Those years are predominantly influenced by parents and elementary teachers. Parents and elementary teachers should be made aware that early exposure to reading text from computer screens may be helpful and encouraged to provide children with a variety of computer screen reading experiences. Educators need to remember the differences in students' computer experiences and modify practices to help facilitate more efficient learning.

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Table 1
Pearson Correlations of Reading Rate and
Questions about Previous Computer Experience

	RATE	QU1	QU2	QU3
RATE	1.000			
QU1	0.291	1.000		
QU2	-0.203	-0.253	1.000	
QU3	-0.287	-0.260	0.252	1.000

Note. N=240

Table 2
ANOVA Summary Table

SOURCE	SOS	DF	MS	F	P
GP	36.196	3	12.065	0.701	0.552
TYPE	334.940	1	334.940	19.473	0.000
GP*TYPE	5.429	3	1.810	0.105	0.957
ERROR	3835.601	223	17.200		

Note. N=231
GP = classification of 4 screen color combinations
Type = type of computer user